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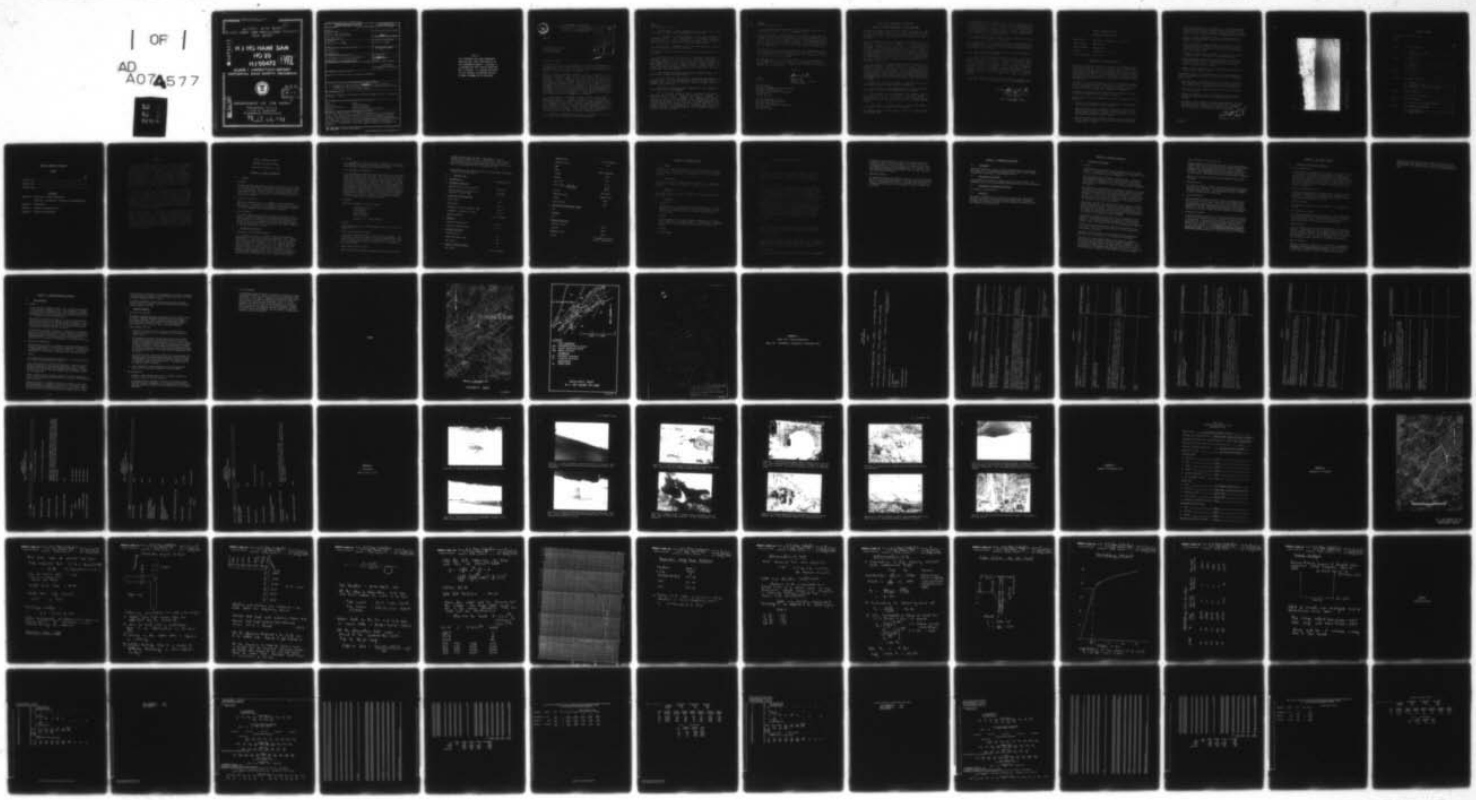

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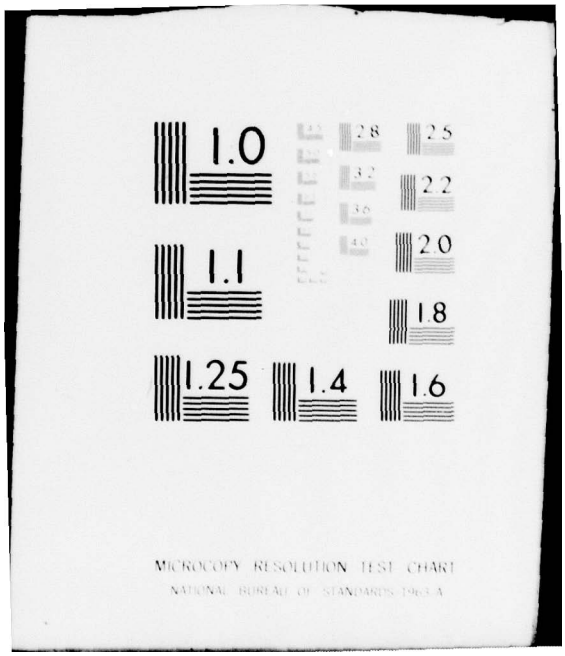
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HUDSON RIVER BASIN
BLACK CREEK TRIBUTARY, SUSSEX COUNTY
NEW JERSEY

NJ NO NAME DAM
NO 20
NJ 00472

LEVEL II

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

August 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NJ00472	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program NJ No Name Dam No. 20 Sussex County, N.J.	5. TYPE OF REPORT & PERIOD COVERED: (9) FINAL report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): (10) Posch, Anthony G. P.E. / Posch	8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Harris-ECI 453 Amboy Ave. Woodbridge, N.J.	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 82
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE: August 1979 13. NUMBER OF PAGES: 40
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(6) National Dam Safety Program. [redacted] No Name Dam Number 20 (NJ-00472), Hudson River Basin, Black Creek Tributary, Sussex County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	Riprap
Spillways	Visual Inspection
NJ No Name Dam No 20	Structural Analysis
Seepage	National Dam Inspection Act Report

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

25 SEP 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for New Jersey No Name Dam No. 20 in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, New Jersey No Name Dam No. 20, a high hazard potential structure, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 73 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The design of an adequate spillway should be accomplished by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Spillway construction should be initiated within calendar year 1980. A low level discharge should also be provided. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Determine the most appropriate way to correct the seepage problem which is evident in the downstream slope of the dam.

(2) Determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of observation wells or piezometers to facilitate seepage studies.

(3) Prepare a topographic survey of the dam and produce a detailed plan and several cross-sections of the dam.

Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within six months from the date of approval of this report the embankment material that has been eroded from the downstream face, particularly adjacent to the turn in the road, should be replaced with quarry-process stone or gravel. Slopes should be reconstructed with keying and compaction of material to improve stability. Slopes should not be steeper than 2H:1V and should be protected with riprap near the proposed spillway and on the upstream face.

d. The following remedial actions should be completed within one year from the date of approval of this report:

(1) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

(2) Form a protected channel downstream of the discharge pond outlet culvert and rebuild headwalls.

(3) A formalized program of annual inspection of the dam by an experienced party should be initiated, utilizing the standard visual check-list in this report. Headwater and tailwater gages should be installed in the dam, and read during severe rainstorms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments, and any change in seepage rates should be noted and evaluated.

e. The present discharge culvert should be blocked upon completion of the spillway, to prevent erosion of the embankment face.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

NEW JERSEY NO NAME DAM NO. 20 (NJ00472)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 8 May 1979 by Frederic R. Harris Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

New Jersey No Name Dam No. 20, a high hazard potential structure, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 73 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

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(1) Determine the most appropriate way to correct the seepage problem which is evident in the downstream slope of the dam.

(2) Determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of observation wells or piezometers to facilitate seepage studies.

(3) Prepare a topographic survey of the dam and produce a detailed plan and several cross-sections of the dam.

Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within six months from the date of approval of this report the embankment material that has been eroded from the downstream face, particularly adjacent to the turn in the road, should be replaced with quarry-process stone or gravel. Slopes should be reconstructed with keying and compaction of material to improve stability. Slopes should not be steeper than 2H:1V and should be protected with riprap near the proposed spillway and on the upstream face.

d. The following remedial actions should be completed within one year from the date of approval of this report:

(1) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

(2) Form a protected channel downstream of the discharge pond outlet culvert and rebuild headwalls.

(3) A formalized program of annual inspection of the dam by an experienced party should be initiated, utilizing the standard visual check-list in this report. Headwater and tailwater gages should be installed in the dam, and read during severe rainstorms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments, and any change in seepage rates should be noted and evaluated.

e. The present discharge culvert should be blocked upon completion of the spillway, to prevent erosion of the embankment face.

APPROVED: James G. Tow
JAMES G. TOW
Colonel, Corps of Engineers
District Engineer

DATE: 22 Sep 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: New Jersey No Name No. 20, I.D. NJ00472

State Located: New Jersey

County Located: Sussex County

Stream: Tributary to Black Creek

Date of Inspection: May 8, 1979

Assessment of General Condition

New Jersey No Name No. 20 Dam is an earth-fill road embankment approximately 31 feet high and 1,220 feet in overall length. The dam is in poor overall condition. There is extensive seepage through the downstream face of the embankment, which has led to back erosion and very soft conditions at the toe. The dam embankment is very poorly defined and has no formal spillway; only a 27 inch diameter discharge culvert. Tree growth on the downstream face is very heavy. The hazard potential is rated "high."

The safety of New Jersey No Name No. 20 Dam is considered questionable in view of its lack of discharge capacity to pass one-half of the PMF without overtopping the dam. The discharge is capable of passing a flood equal to 36% of the PMF and is assessed as "inadequate."

As present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam.

The following actions are recommended, along with a timetable for their completion.

1. Establish a flood-warning system for the Playboy Club downstream and for users of Route 517 within 3 months.

2. Carry out a more precise hydrologic and hydraulic analysis of the dam within three months, to determine the need and type of mitigating measures necessary. Conduct a study and design of a spillway capable of passing a flow of 1/2 PMF.

3. Conduct studies within 3 months to determine the most appropriate way to correct the seepage problem which is evident in the downstream slope of the dam.

4. Install observation wells or piezometers in the downstream embankment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be commenced within 3 months.

5. Conduct a complete topographic survey of the dam area within 3 months, in order to develop a detailed plan and several cross sections of the dam.

6. Construct a formal concrete spillway for the dam based on the studies made, within 12 months. The spillway should provide for a low-level outlet, a bridge and a trash screen, and for headwater and tailwater gages.

7. Construct or install, within 6 months, a suitable form of cutoff or impervious wall as determined by the recommended study.

8. Replace embankment material that has been eroded from the downstream face, giving slopes no steeper than 2H:1V. Rip-rap protection should be provided on the upstream face and the work should be completed within 6 months.

9. Remove trees and vegetation from the embankment and seed exposed faces with grass within 12 months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within a reasonable period of time.

1. A program should be developed to monitor the seepage through the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

2. Block off the 27 inch diameter discharge culvert after completion of the new spillway.

3. Rebuild the headwalls of the 5 foot diameter discharge culvert, and provide slope protection on the downstream face below the culvert.

4. A program of annual inspection and maintenance should be initiated. This should include lowering the lake, and updating the operation and maintenance log. Movement and settlement of the embankment should also be monitored by means of surveying monuments.

Anthony G. Posch, P.E.

AGP/REJ:cc

New Jersey No Name 20 Dam
Overall view of dam from upstream.

May 8, 1979

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PREFACE

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APPENDICES

[redacted]

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NEW JERSEY NO NAME NO. 20 DAM

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of N. J. No Name No. 20 Dam was made on May 8, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project, presents a summary of visual observations made during the field inspection, an evaluation of hydrologic and hydraulic conditions at the site, an evaluation as to the structural adequacy of the various project features, and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

N. J. No Name No. 20 Dam is a poorly defined earth embankment, approximately 31 feet high, founded on sedimentary rock. Pleasant Valley Road a, 2-lane paved road, forms the crest of the dam and the overall length of the dam is 1,220 feet. The dam does not have a spillway. It is drained by a 27 inch diameter reinforced concrete outlet pipe, which discharges into a small pond to the left of the lake. The discharge pond is drained by a 5 foot diameter corrugated metal culvert, which discharges directly onto the downstream embankment face. The discharge pond performs no specific function other than its use for recreational fishing.

b. Location

N. J. No Name No. 20 Dam is located on Pleasant Valley Lake in the Township of Vernon, Sussex County, New Jersey. It is accessible by means of Pleasant Valley Road off Route 94.

c. Size and Hazard Classification

N. J. No Name No. 20 Dam has a structural height of 31 feet and a reservoir storage of 362 acre-feet. Since its storage is less than 1,000 acre-feet and its height is less than 40 feet, it is classified in the dam size category as being "small." A hazard potential classification of "high" has been assigned to the dam on the basis that failure would result in excessive damage to the road and overhead electric cables across the dam and to downstream property, including Route 517 and the Playboy Club at Great Gorge. Because the lake is used for recreational purposes, and because the Playboy Club is densely populated at all hours, the possibility exists of the loss of more than a few lives in the event of dam failure. There are no inhabitable buildings in the flood-path other than those mentioned.

d. Ownership

New Jersey No Name No. 20 Dam is owned by:

Baldwine Enterprises
Vernon Realty
P. O. Box 307
Vernon, NJ 07462
(201) 764-4055

Attention: Mr. Robert Baldwine

e. Purpose

New Jersey No Name No. 20 Dam is presently used for recreational purposes only.

f. Design and Construction History

The present embankment was built over a smaller embankment. The construction date is not known. The present embankment was built up in the early 1950's and the road was paved over in 1971. However, no drawings or calculations pertaining to the embankment are known to exist.

g. Normal Operational Procedures

Water from the lake discharges primarily through the unregulated

concrete culvert under the road. Approximately 3 cfs of seepage passes through the dam. In the event of heavy rainfall the discharge culvert is prone to blockage with debris as the lake rises, and the owner undertakes the clearing of debris only when the water appears likely to overflow the road.

No maintenance of the dam, other than for recreational enhancement, is known to have taken place.

1.3 Pertinent Data

a. Drainage Area:	0.25 square miles
b. Discharge at Dam Site	
Maximum known flood at dam site:	Over road.
Total discharge pipe capacity at elevation of top of dam:	80 cfs (el. 563')
c. Elevation (Feet above MSL)	
Top of dam:	563'
Pipe invert:	560.7'
Maximum pool design surcharge (SDF):	563.04'
Streambed at centerline of dam:	531.6'
Maximum tailwater:	532' (estimate)
d. Reservoir	
Length of maximum pool:	4,500' ±
Length of recreation pool:	3,500' ±
e. Storage (Acre-feet)	
Recreation pool:	362
Design surcharge (SDF):	451
Top of dam:	449
f. Reservoir Surface (Acres)	
Top of dam:	43.2 (estimate)

Maximum pool:	43.5 (estimate)
Recreation pool:	36.1

g. Dam

Type:	Earth embankment
Length:	1,218'
Height:	31.4'
Top width:	40' ±
Side Slopes - Upstream:	2H:1V
- Downstream:	2H:1V
Zoning:	Not known.
Impervious core:	Assumed none.
Cutoff:	None.
Grout curtain:	None.

h. Diversion and Regulating Tunnel

N/A

i. Spillway

N/A

j. Regulating Outlets

Low-level outlet:	None.
Controls:	None.
Emergency gate:	None.
Outlet:	27" diameter concrete culvert, unregulated.

SECTION 2: ENGINEERING DATA

2.1 Design

No drawings or computations pertaining to original design of the dam could be found. No data from soil borings, soil tests or other geotechnical data is available. A sketch based on field notes has been included.

2.2 Construction

Construction history has been provided in Section 1.2.f. Engineering data relating to means of construction, earthfill, etc. are not on record.

2.3 Operation

No engineering data concerning the operation of the dam and reservoir are known to exist.

2.4 Evaluation

a. Availability

The availability of engineering data is extremely poor. No data pertaining to the dam is known to exist and it appears that the dam was never formally designed, but rather gradually built up over the years.

b. Adequacy

The engineering data was insufficient to perform even an approximate computation of the dam's stability. A preliminary assessment of the dam could be carried out with the data obtained in the field.

c. Validity

Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

[illegible]

b. Dam

[illegible]

c. Appurtenant Structures

1. Outlet

Pleasant Valley Lake is discharged through a 27 inch reinforced concrete pipe into a discharge pond. The pipe is deteriorated at the inner end and is prone to blockage during heavy rainfall. There is no spillway.

2. Discharge Pond

The discharge pond is filled by discharge from the lake. The pond is drained by seepage and through a 5' corrugated metal culvert. The headwalls of the culvert are cracked extensively. The pond elevation was about 1 foot below the culvert invert at the inspection.

d. Reservoir Area

The slopes around the lake are steep (1.5H:1V) and are of fragmented,

sedimentary rock, covered with trees. The slopes continue into the lake for most of the rim, except for a 500 foot long flat recreation area by the left of the dam. The depth at lake center is estimated to be 25 feet and sedimentation is negligible. The lake sides are developed for residential use; the lake is widely used for boating and fishing.

e. Downstream Channel

The downstream slopes and stream are difficult to assess and define due to heavy tree and brush growth. Many dead trees are across the channel. Downstream of the dam is the Playboy Club, car park and a recreational area within the flood path. Route 517 passes over the stream.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

New Jersey No Name No. 20 Dam is used to impound water for recreation activities only. No operational procedures are known to exist, except for periodic unblocking of the discharge culvert.

4.2 Maintenance of the Dam

No maintenance of the dam on a regular basis is known to occur. Recreational facilities are periodically maintained, and the road resurfaced.

4.3 Maintenance of Operating Facilities

No operating facilities exist.

4.4 Evaluation

The present procedures are not conducive to satisfactory operation of the dam. The level of maintenance is particularly poor, and should be amended by substantial initial repairs followed by a program of regular inspection and maintenance.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above New Jersey No Name No. 20 Dam is approximately 0.25 square miles. A drainage map of the watershed of the dam site is presented on plate 1, Appendix D.

The topography within the basin is steeply sloped. Elevations range from approximately 960 feet above MSL at the west end of the watershed to about 560 feet at the dam site. Land use patterns within the watershed are mostly wooded and partly residential development.

The evaluation of the hydraulic and hydrologic features of the lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the dam falls in a range of 1/2 PMF to PMF. In this case, the low end of the range, 1/2 PMF, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The probable maximum flood (PMF) was calculated from the probable maximum precipatation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed into a curvilinear hydrograph was adopted for developing the unit hydrography, with the aid of the HEC1-DB Flood Hydrograph Computer program.

Initial and infiltration loss rates, using SCS procedures, were applied to the probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the various ratios of PMF utilizing program HEC1-DB.

The SDF peak inflow calculated for New Jersey No Name No. 20 Dam is 367 cfs. This value is drived from the 1/2 PMF, and results in over-topping of the dam.

The stage-outflow relation for the discharge pipe was determined manually, upon consideration of field notes and photographs.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC1-DB program. The conic method assumes that the reservoir capacity resembles a series of vertically stacked cones. The reservoir surface areas at various elevations were measured by planimeters from U.S.G.S. Quadrangle topographic maps. Reservoir storage capacity included surcharge

levels exceeding the top of the dam.

A breach analysis indicates that the stage of the stream where it crosses Route 517 is 2 feet higher, due to dam failure from overtopping, than it would be without failure. This is likely to jeopardize the well-traveled road and to increase the potential for loss of life downstream, but not significantly more than without failure. The discharge facility is thus rated "inadeguate."

There is no low-level outlet and thus no drawdown calculations were made.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, it is known that the dam was overtopped following a flood in 1971. The one discharge culvert is known to be easily blocked when the lake rises.

c. Visual Observation

The valley below the dam is densely covered with trees and brush and has steep (1.5H:1V) sides. Downstream is the Playboy Club, a car park and a recreational area, and a well travelled road. The presence of these occupied areas confirms the "high" hazard potential of the dam. The slopes around the lake are covered with trees and in one area a beach, but do not appear to be unstable.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of .04 feet, provided the discharge culvert is not blocked. Computations indicate that the dam can pass approximately 36% of the PMF without overtopping the dam crest. Since one half the PMF is the minimum Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the discharge capacity of New Jersey No Name No. 20 Dam is assessed as "inadequate."

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

At the time of the inspection, the condition of the dam gave rise to concern about its stability and adequacy to perform its present function. The seepage observed through the embankment indicates poor maintenance, and improper construction and presents the greatest potential threat to stability. The extent of erosion, the lack of a spillway, the heavy growth of large trees and the poor toe drainage combine to present a hazardous situation with regard to stability.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. No foundation or embankment soil parameters, nor drawings of the dam or any relevant data are available to carry out stability computations for the dam.

c. Operating Records

No operating records are available relating to the stability of the dam.

d. Post Construction Changes

The present embankment was built up from an original embankment in the early 1950's and the road was paved in 1971. The road has not been paved since then. Most of the seepage appeared to be coming from between the original and 1950 construction.

e. Static Stability

A static stability analysis was not performed for New Jersey No Name No. 20 Dam because the lack of data on which to base assumptions of material properties and embankment cross-sections might produce misleading results. The recommended remedial actions must be implemented in order to decrease the risk of local failure, and the present static stability is regarded as questionable.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zone 0, 1 and 2 may be assumed to present no hazard from earthquake,

provided the static stability conditions are satisfactory and conventional safety margins exist. Until the last two conditions are confirmed, the seismic stability must be considered questionable.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report, and in the extreme lack of engineering data.

The safety of New Jersey No Name No. 20 Dam is in question because the dam does not have adequate discharge capacity to pass the PMF or even one-half of the PMF without overtopping. The dam's present discharge capacity is only about 36% of the PMF, provided the discharge pipe does not block.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment and foundation material engineering properties. However, the dam exhibits considerable seepage, and the possibility of failure may exist, particularly in the event of overtopping or of seismic excitation.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the dam's stability. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

All studies and design should be performed by an engineer qualified in the design and construction of dams.

Design and studies for a formal spillway with a discharge capacity capable of passing the SDF should be undertaken within 3 months. The spillway should protect the embankment from erosion to a point beyond the toe, and it should be assumed that the present culvert will be closed off.

Conduct studies within 3 months to determine the most appropriate way to correct the seepage problem which is evident in the downstream slope of the dam.

Observation wells or piezometers should be installed in the downstream embankment to determine the location of the phreatic surface. The borings should be logged according to the Unified Soil Classification system by qualified personnel and samples taken to deter-

mine the values of pertinent soil parameters for stability analyses in accordance with Chapter 4.4 of the Corps Guidelines. This work should be commenced within 3 months.

A complete topographic survey of the dam area should be made within 3 months, in order to develop a detailed plan and several cross-sections of the dam.

7.2 Remedial Measures

a. Provision of a Spillway

An adequate spillway should be constructed to take the SDF, within 12 months. Adequate embankment protection must be provided. The present discharge culvert should be blocked upon completion of the spillway, to prevent erosion of the embankment face. Construction should also allow for a low-level discharge.

b. Other Remedial Measures

1. Construct or install within 6 months, a suitable form of cutoff or impervious wall as determined by the above-recommended study.

2. The embankment material that has been eroded from the downstream face, particularly adjacent to the turn in the road, should be replaced with quarry-process stone or gravel. Slopes should be reconstructed with keying and compaction of material to improve stability. Slopes should not be steeper than 2H:1V and should be protected with rip-rap near the proposed spillway and on the upstream face. This work should be undertaken within six months.

3. All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should than be seeded to develop a growth of grass for surface erosion protection. This program should be completed within 12 months.

4. Form a protected channel downstream of the discharge pond outlet culvert and rebuild headwalls within 12 months.

c. Recommendations

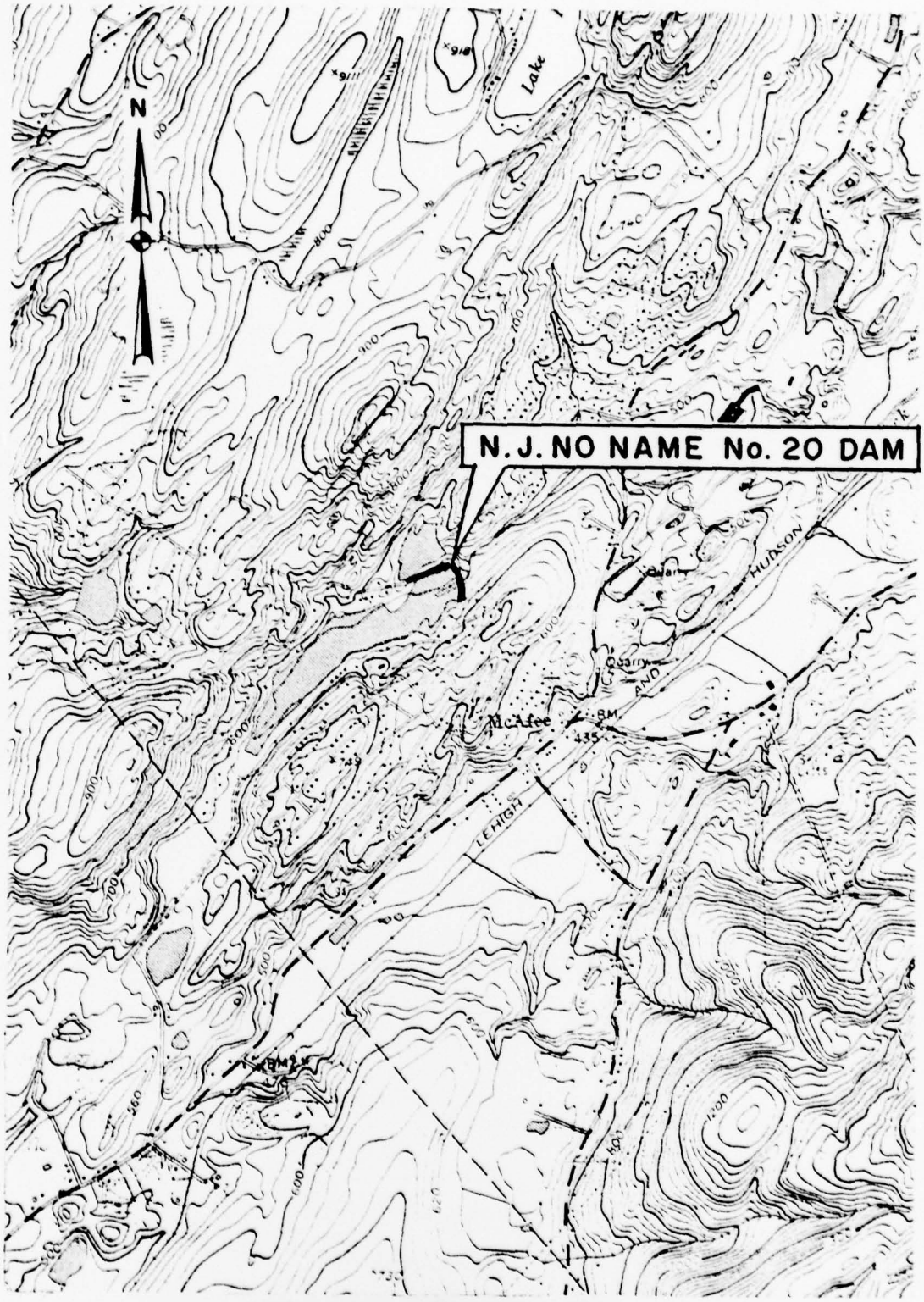
1. Provide a flood-warning system for the Playboy Club and for traffic on Route 517 within 3 months.

2. A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

d. O & M Procedures

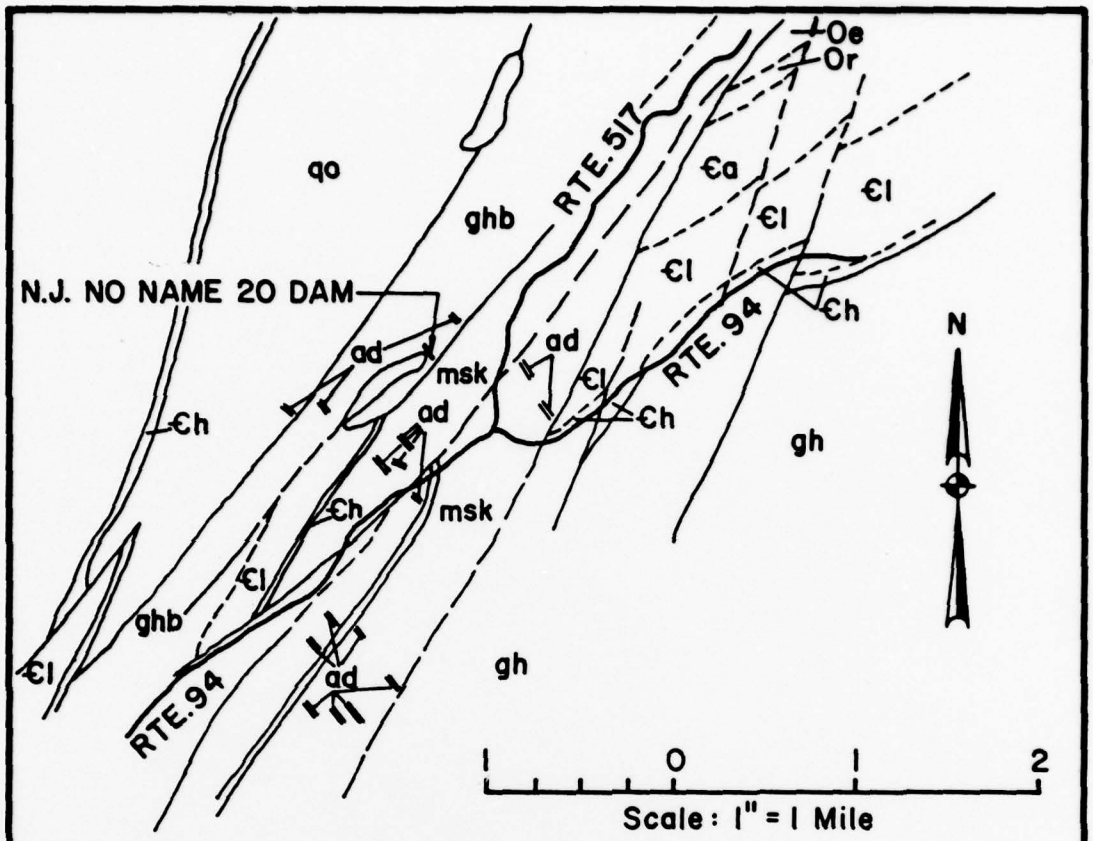
A formalized program of annual inspection of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read during severe rain storms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments, and any change in seepage rates should be noted and evaluated.

PLATES



VICINITY MAP

PLATE 1



LEGEND

PRE-CAMBRIAN

ghb	Hornblende and Biotite Gneiss
qo	Quartz-Oligoclase Gneiss
msk	Marble and Skern

CAMBRIAN

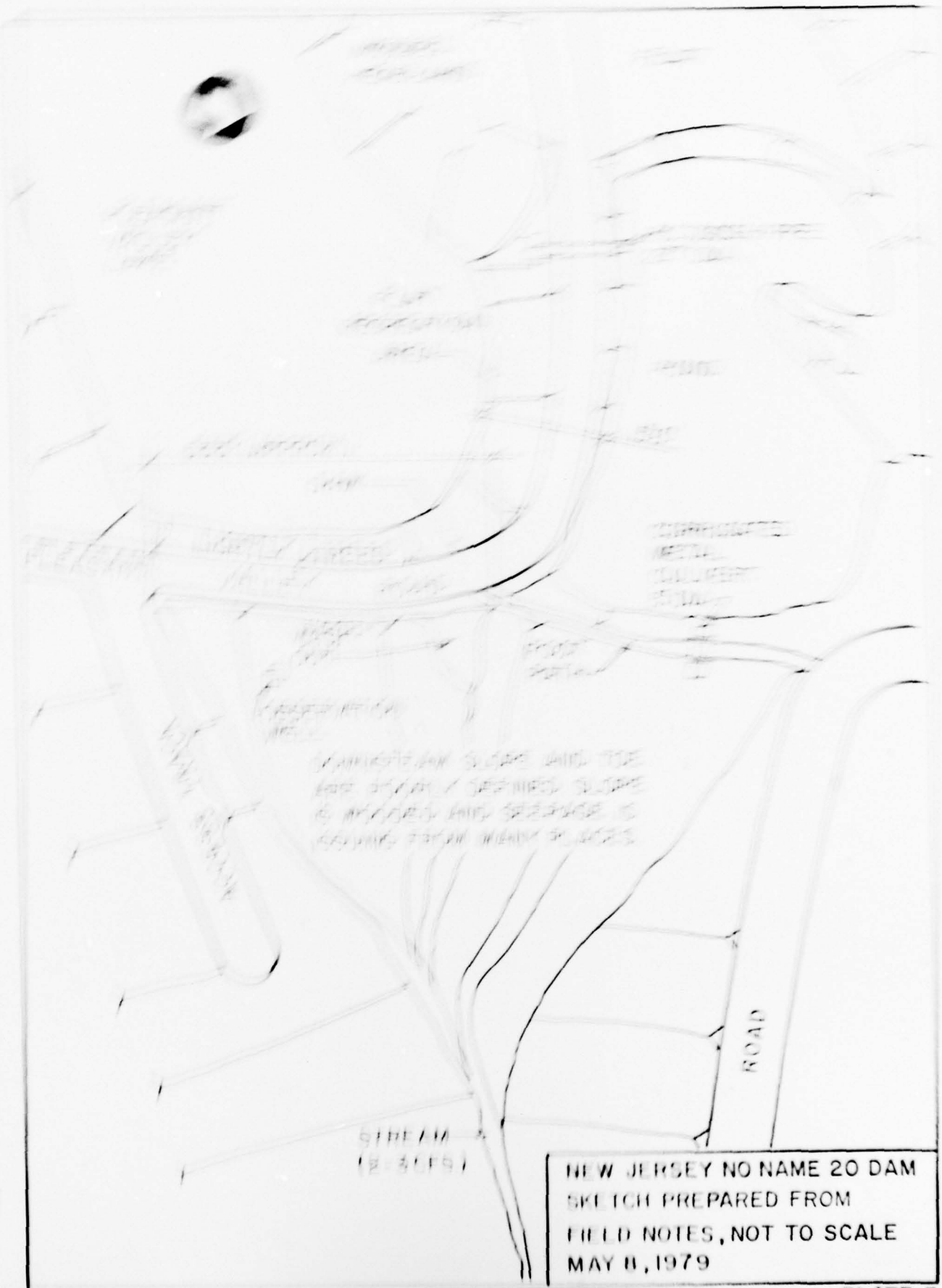
€h	Hardyston Sandstone
€l	Leithsville Formation

ORDOVICIAN

ad	Alkalic Dikes

GEOLOGIC MAP
N. J. NO NAME 20 DAM

PLATE 2



NEW JERSEY NO NAME 20 DAM
SKETCH PREPARED FROM
FIELD NOTES, NOT TO SCALE
MAY 8, 1979

PLATE 3

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION

PHASE I

Name of Dam N. J. No Name No. 20 Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection May 8, 1979 Weather Sunny-Clear Temperature 70°-80°F

Pool elevation at Time of Inspection 561' M.S.L. Tailwater at time of Inspection 555.12' M.S.L. (Discharge Pond El.)

Inspection Personnel:

R. Ernest-Jones
E. Koo
H. King
C. Chin

Owner/Representative:

Mr. Robert Baldwine

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	Minor cracking in the paved road on top of the embankment. No other cracks apparent. Cracks do not appear to be related to movement of the embankment.	Monitor movements by surveying monuments.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The fill at the toe is saturated and covered with a growth of weeds. Toe is not well stabilized against local movement.	Conduct a study to investigate stability of the dam.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Slopes are not well defined, but are all approximately 2H:1V. Seepage in embankment has led to back-erosion, leaving dangerously narrow cross-sections. In other areas, dumping of spoil or water transported material have created abnormally wide sections. The worst washed-out area is opposite the turn in the road; here at least 30-40 cubic yards have been lost leaving a large local gulley.	Determine cross-sections at several locations. Replace material that has been eroded.
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	The lowest point in the embankment is at the turn in the road. No appreciable misalignment to suggest instability, but original alignment is not known.	
RIPRAP FAILURES	There is no rip-rap.	Add rip-rap on upstream face and adjacent to proposed spillway.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
VEGETATION	The tree growth on the embankment is so well developed that parts of it must have been in place for over fifty years.	Remove all trees from embankment faces.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	Considerable seepage beginning approx. 20' below crest elevation. Total seepage (estimated at confluence of all tributary seepage streams) is 3 cfs. Artesian type activity in three places, but water running clear. Entire toe area of embankment is wet and only supports human weight in small areas.	Conduct an investigation of seepage to determine the most appropriate form remedial measures.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN	N/A	
INTAKE STRUCTURE	The intake to the discharge culvert from the lake is a recessed basin, confined by low concrete retaining walls in good condition.	The intake has no trash screen and is prone to blockage with debris.
OUTLET STRUCTURE	Pleasant Valley Lake is drained by a 27 inch diameter reinforced concrete pipe culvert under Pleasant Valley Road. The pipe discharges into a drainage pond and is functional but deteriorated at its lower end.	The owner reports that the pipe is able to drain 2 feet off the lake in one day, when not obstructed.
OUTLET FACILITIES	The discharge pond is drained by a 5 foot diameter corrugated metal culvert which discharges onto the downstream embankment face. The culvert was partly blocked at the time of inspection. The headwalls of the culvert are structurally inadequate. Cracking is so extensive as to make them unfit for their prupose of securing the pipe and holding back fill.	Rebuild headwalls.
EMERGENCY GATE	None	The lake should be provided with a formal spillway and a low-level outlet.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Approximately 1.5H:1V around lake mostly tree covered, and of dark gray fragmented, sedimentary rock. Near the dam a 500 foot long flat recreation area exists on the left, but away from this area side slopes can be seen to continue directly into the reservoir.	
SEDIMENTATION	A depth of 25 feet in the center was established by the owner, and no appreciable sedimentation is known to have built up.	
USE	The lake is used by a local country club for fishing. Otherwise it is for the sole recreational use of residents of the lake area. Weekends, it is crowded and during the week has 0-10 people on it.	
SHORELINE BUILDINGS	Many dwellings are on the shoreline, approximately 100 or so houses around the lake. A boating club on the left bank at the dam is periodically occupied.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Assessment and definition of slopes and stream is impossible due to heavy tree and brush growth. Many dead trees across the channel. The boundary between the gorge and the embankment is very indistinct. A single stream approx. 4 inch deep and 5 feet wide winds away through the gorge.	
SLOPES	Approximately 1.5H:1V. Heavily wooded with houses at the top of the slopes.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Playboy Club check booth, car park and recreational areas are all in flood path. No other private dwellings. Sussex 517 passes over stream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available. See field sketch.
REGIONAL VICINITY MAP	U.S.G.S. Quad Sheet for Hamburg, New Jersey.
CONSTRUCTION HISTORY	Foundation of dam is on embankment which originally held up a much smaller lake. Construction date of this is not known. The present embankment was built up in the early 1950's and the road was paved over in 1971. It has not been repaved since. (Verbal records only).
TYPICAL SECTIONS OF DAM	Not available.
HYDROLOGIC/HYDRAULIC DATA	None.
OUTLETS - PLAN	Not available.
- DETAILS	Not available.
- CONSTRAINTS	Not available.
- DISCHARGE RATINGS	Not available.
RAINFALL/RESERVOIR RECORDS	Not available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Not known.
SPILLWAY PLAN - SECTIONS - DETAILS	Not applicable.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None.
MONITORING SYSTEMS	None.
MODIFICATIONS	See construction history.
HIGH POOL RECORDS	Up to road level.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	1. In 1971 when the lake rose up to the road. 2. Owner was called following a storm in 1978. Unblocking of concrete discharge pipe led to the water level dropping to present level in one day.
MAINTENANCE OPERATION RECORDS	None.

APPENDIX B

PHOTOGRAPHS

(Taken on May 8, 1979)

Photo No. 1 - View of Pleasant Valley Lake and dam from the left.

Photo No. 2 - View of the crest of the embankment (Pleasant Valley Road), from the flat recreation area.

Photo No. 3 - View of Pleasant Valley Road looking to the right. Note the crack in the pavement and the trees on the upstream slope of the embankment.

Photo No. 4 - View of the drainage pond to the left of the lake. Note the 5' Armco discharge culvert in the background and the 27" inlet from Pleasant Valley Lake on the right.

Photo No. 5 - View of 27" diameter concrete outlet from Pleasant Valley Lake. This is the only drainage structure from the lake.

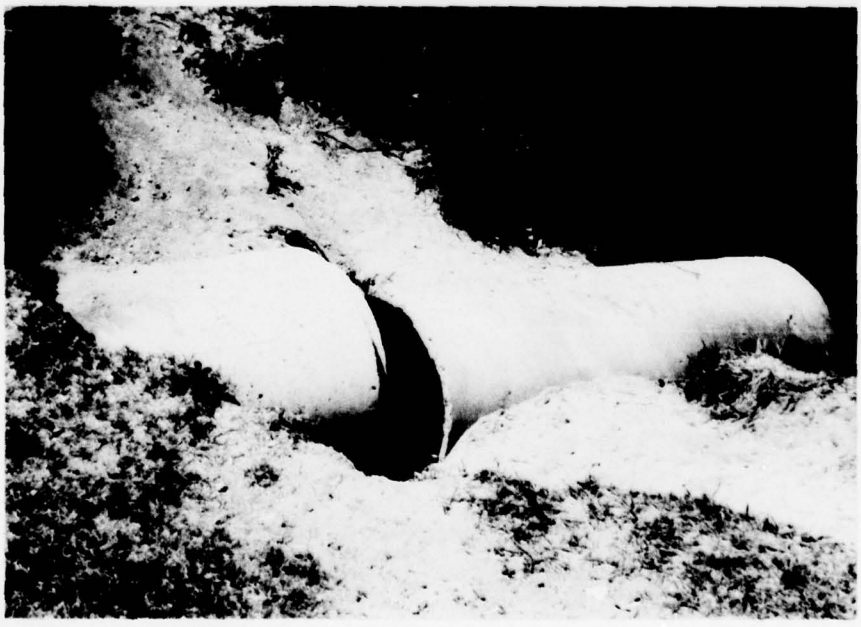


Photo No. 6 - Detail of the 27" diameter outlet discharging into the pond. Note the deteriorated condition. No flow was occurring at the inspection.

Photo No. 7 - View of 5 foot diameter Armco discharge culvert from the pond. Note deteriorated and cracked headwall. Headwall at other end has partly collapsed. The culvert drains directly onto the embankment face.

Photo No. 8 - View of observation well approximately 20' below the embankment crest. Note discolored seepage in the surrounding area.

Photo No. 9 - Typical view of seepage along the downstream face of the embankment.

Photo No. 10 - View of washed out area on the downstream face at the turn in the road. Note fallen trees and debris in the area.

Photo No. 11 - View of reservoir looking upstream. Pleasant Valley Road continues to the right of the wooded headland in the middle distance (behind raft). Note the steep wooded slopes and the lakeside houses.

Photo No. 12 - View of ill-defined downstream channel. Note heavy tree and brush growth.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: New Jersey No Name No. 20 Dam

Drainage Area Characteristics: Steeply sloped, wooded and minor residential.

Elevation Top Normal Pool (Storage Capacity): 560.7' MSL (362 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 563.04' MSL (451 acre-feet)

Elevation Top Dam: 563' MSL (449 acre-feet)

SPILLWAY CREST

a. Elevation N.A

b. Type N/A

c. Width N/A

d. Length N/A

e. Location Spillover N/A

f. No. and Type of Gates N/A

OUTLET WORK

a. Type 27" diameter concrete pipe.

b. Location Under road, upstream section of dam.

c. Entrance Inverts 560.70' MSL

d. Exit Inverts 555.12' MSL

e. Emergency Draindown Facilities None.

HYDROMETEOROLOGICAL GAGES

a. Type None.

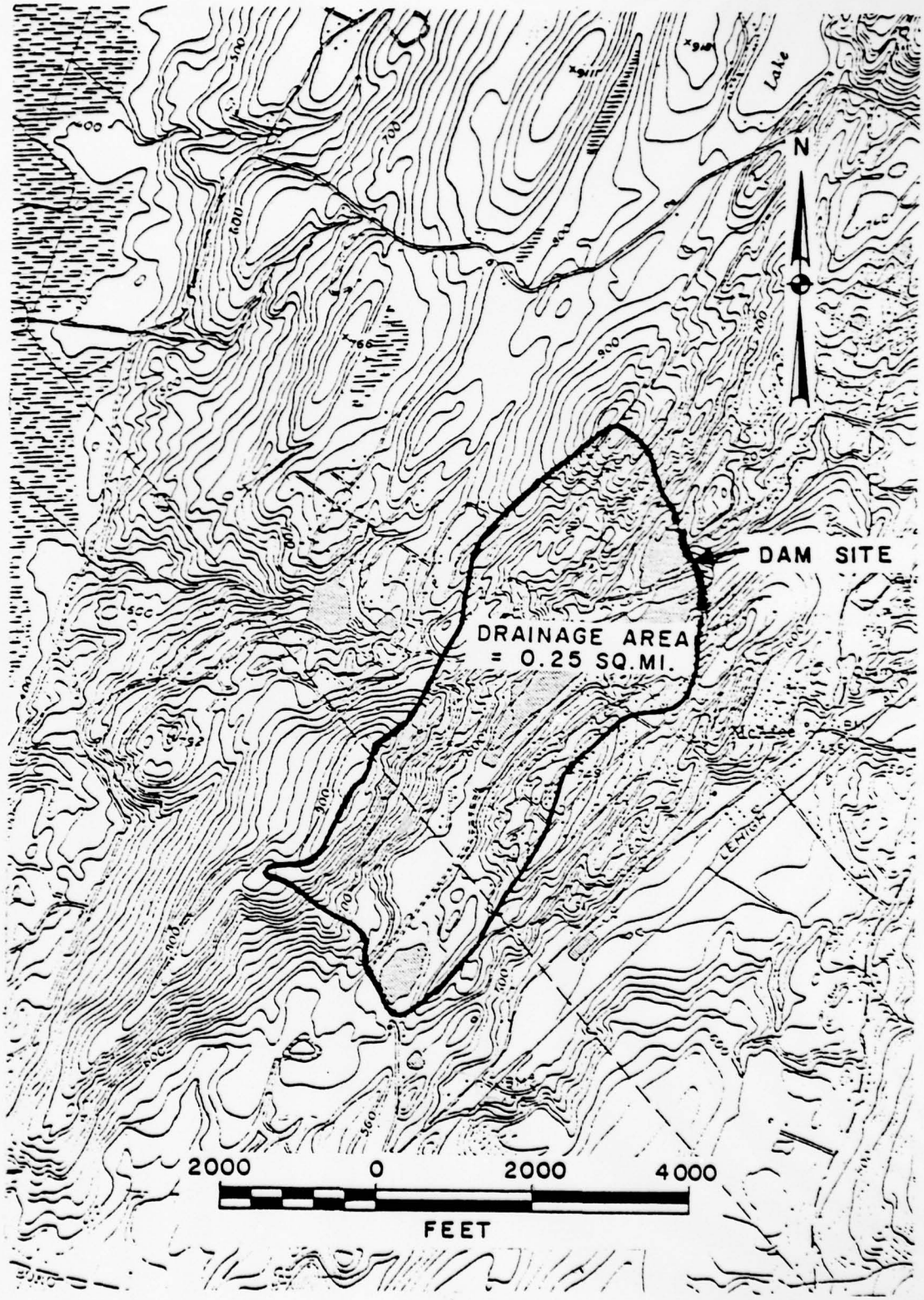
b. Location None.

c. Records None.

MAXIMUM NON-DAMAGING DISCHARGE 80 cfs

APPENDIX D

HYDROLOGIC COMPUTATIONS



N.J. NO NAME No. 20
DRAINAGE BASIN

Area of the Lake at normal pool level ;

Area measured from U.S.G.S Quad (El=561)

= 38 AC (El estimated from U.S.G.S.)

Area at Contour 560 = 31 AC
(Previous contour line before the lake)

Hight of the Dam = 30 ft

Small Dam, High Hazard

S.D.F = $\frac{1}{2}$ PMF

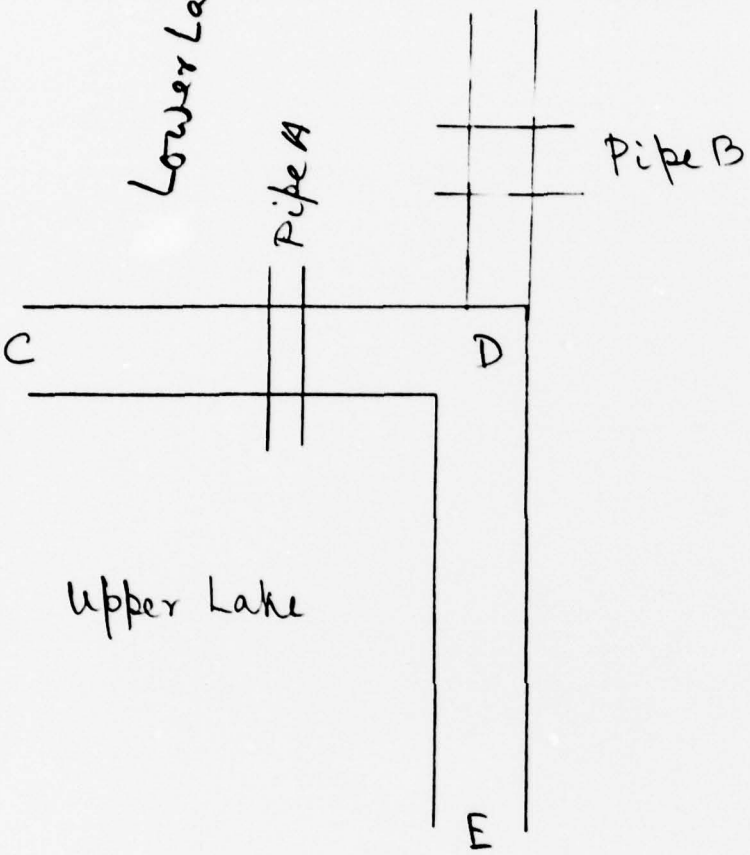
Hydrologic analysis :-

D.A = 0.25 sq mile.

Inflow Hydrograph at Reservoir was determined using HEC 1 DB program. Inflow routed through the reservoir

SPILLWAY AND DAM

Schematic Layout of Dam



Following assumptions are made in the analysis

① Upper lake and Lower lake are seperated by the road CD

② When the Road CDE is overtopped there is no attenuation in the lower lake

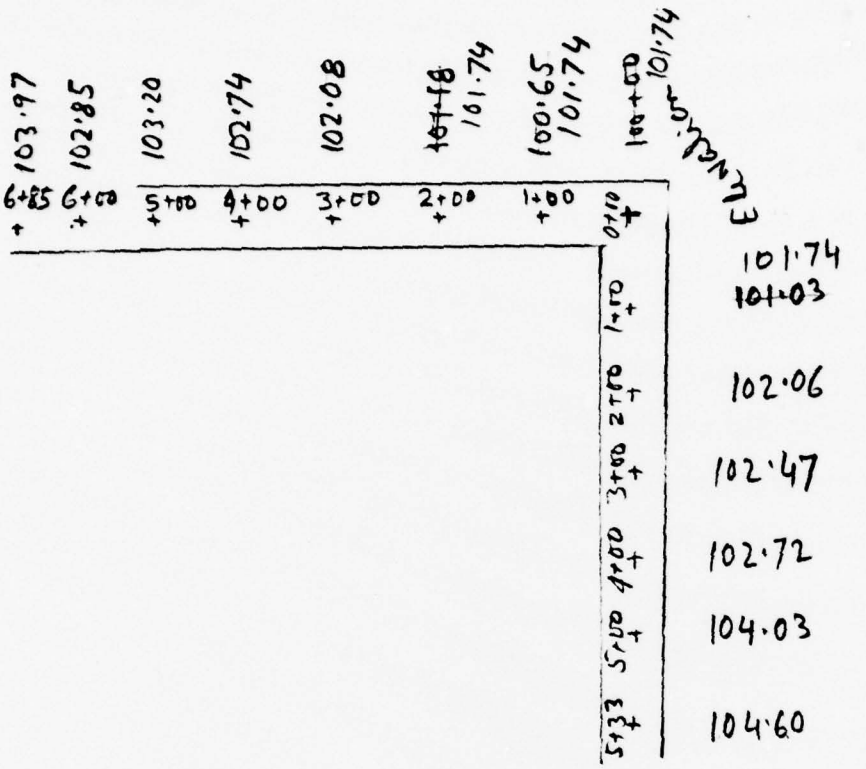
③ Storage in the upper lake is effective in routing.

④ Outflow through pipe A is similar to spillway discharge in Dam Inspection Study.

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
N.J. No Name 20
COMPUTED BY S.B CHECKED BY

SHEET No. 3 OF
JOB No. 10-A20-C1
DATE July 1979



Av. El = 102.69

Elevation and stations are obtained in the field from an arbitrary datum.

Normal Pool level with arbitrary datum = 100.74

Normal Pool level (level of Lake) estimated from U.S.G.S Quad = 561.00

All the elevations observed in the field are to be added with 460.26 to get actual el.

At the junction of Road the bank of road is higher than the CL of Rod. Minimum elevation of bank was found to be one foot higher than the water level. Therefore Road elevation is minimum ≈ 101.74

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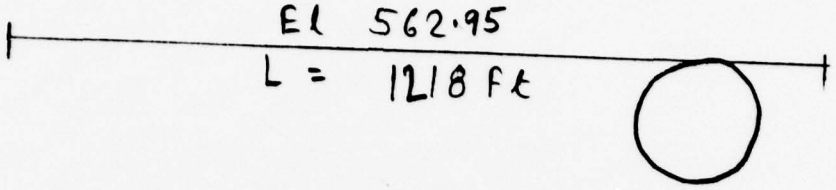
SUBJECT N.J. Dam Inspection
N.J. No Name 20
COMPUTED BY S.B. CHECKED BY

SHEET NO. 4 OF
JOB NO. 10-A20-01
DATE July 1979



Pool Elevation = 100.74 + 460.26 = 561

At the day of observation W.El was 0.25 ft (3") above the invert of the pipe.

∴ Pipe invert = 561.00 - 0.30 = 560.70

Pipe Crown (27" pipe) = 560.70 + 2.25 = 562.95

Water level in the D.S. end of the pipe
i.e, Lower lake = 94.86 + 460.26 = 555.12

At the observation date water is found to be 3" above the invert.
Pipe is 90 ft long.

Slope of pipe = $\frac{562.95 - 555.12}{90} = .087$

Upto the full capacity the pipe will flow at Normal depth the pipe

$$Q = \frac{1.486}{n} R^{2/3} S_0^{\frac{1}{2}} \times A$$

$$= \frac{1.486}{.015} \cdot \left(\frac{2.25}{4}\right)^{2/3} (.087)^{\frac{1}{2}} \times \frac{\pi}{4} \times (2.25)^2$$

Full flow = 80 cfs.

Half full Condition = 40 cfs.

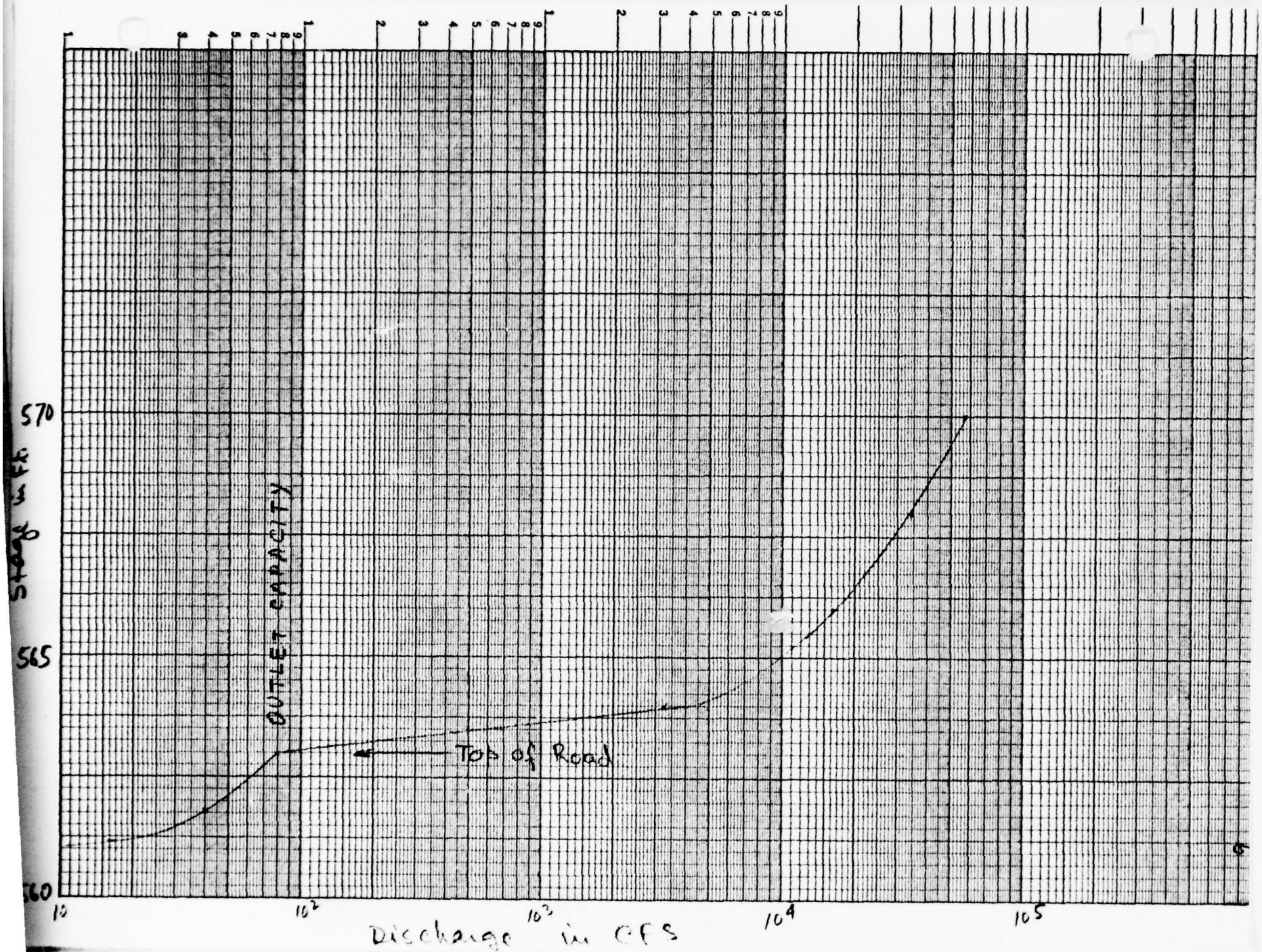
When the water will be flowing over the road, the lower lake will be in the same elevation. Pipe flow will not be predominent.

Flow over the Road $Q = CL H^{3/2}$

$= 2.5 \times 1218 H^{3/2}$

$= 3045 H^{3/2}$

W.S. el	H	$Q = 3045 H^{3/2}$	Total Q
560.7			0
561.8			40
562.95			80
564	1.05	3276	3,276
566	3.05	16,219	16,219
568	5.05	34,556	34,556
570	7.05	57,000	57,000


570
565
560
OUTLET CAPACITY
Top of Road
Discharge in CFS

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SUBJECT N.J. Dam Inspection
N.J. No Name 20
COMPUTED BY S.B CHECKED BY

SHEET No. 7 OF
JOB No. 10-A20-01
DATE July 1979

Reservoir Stage Area Relations

Elevation	Area in Acres.
* 530	0
561 (Pool elevation)	36.1 Ac
580	81 Ac
600	99.8 Ac

* Bottom of the Lake is considered at an elevation of 69.29 (arbitrary Datam)
4, 69.29 + 460.26 ≅ 530

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SUBJECT N.J. Dam Inspection — N.J. No Name 20
COMPUTED BY S-B CHECKED BY
SHEET No. 8 OF
JOB No. 10-A20-01
DATE July 1, 1979

Determination of PMP

PMP amount from HMS Report 33
= 22 " (200 sq miles – 24 hrs
all season envelope

Depth area duration relationship.

Because of the unlikelihood of a perfect strike of a storm center on any particular small basin, no variation is assumed between point and 10. square mile precipitation

Depth area duration relationship.
Percentage to be applied to the above figure.

ZONE 6

6 hr	- 112
12 hr	- 123
24 hr	- 132
48 hr	- 143

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SUBJECT N.J. Dam Inspection — N.J. No. Name 20
COMPUTED BY S.B. CHECKED BY
SHEET NO. 9 OF
JOB NO. 10-A20-01
DATE July 1979

Determination of Tc

1) Estimating Tc from velocity estimate and watercourse length.

	Slope	Vel	Remarks
Overland flow	$\frac{70}{600} \times 11\%$	5 ft/sec	Pastures (upper portion of watershed)
Reach 1	$\frac{20}{2800} = .7\%$	1 ft/sec	Natural channel (Neglect flow thro' lake)

$$Tc = \frac{600}{5 \times 3600} + \frac{2800}{1 \times 3600}$$

$$= .81 \text{ hrs}$$

2) Estimating Tc assuming same vel.

$$Tc = \frac{3400}{1 \times 3600} = .94 \text{ hrs.}$$

3) From Nomograph of design of Small Dam (S.C.S. Guide) – same as Kirpich

$$Tc = \left(\frac{11.9\,L^3}{H}\right)^{.385}$$

L in Miles = .64 miles (Lake excluded)
H in feet = 90 ft

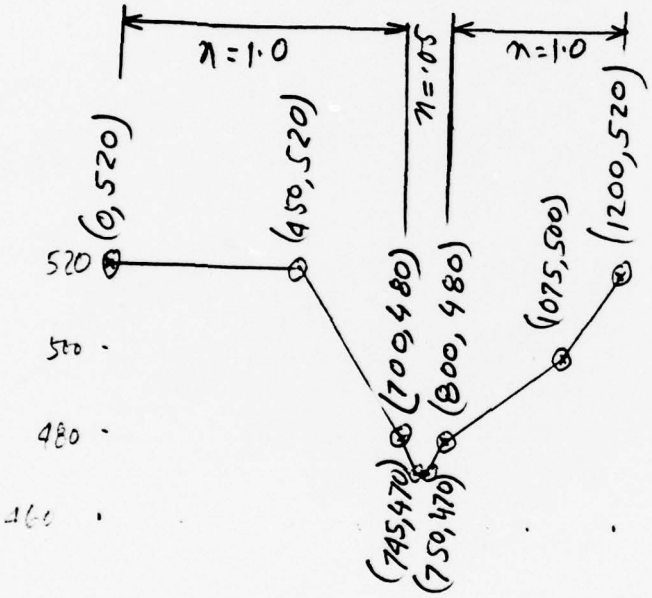
$$= \left[\frac{11.9 \times (.64)^3}{90}\right]^{.385}$$

$$= .274 \text{ hrs.}$$

Use Tc = .9 hrs

Lag = $0.6 \times .9 = .54$ hrs.

Cross Section at D/S Reach



Reach 1

$L = 2{,}000$ Ft

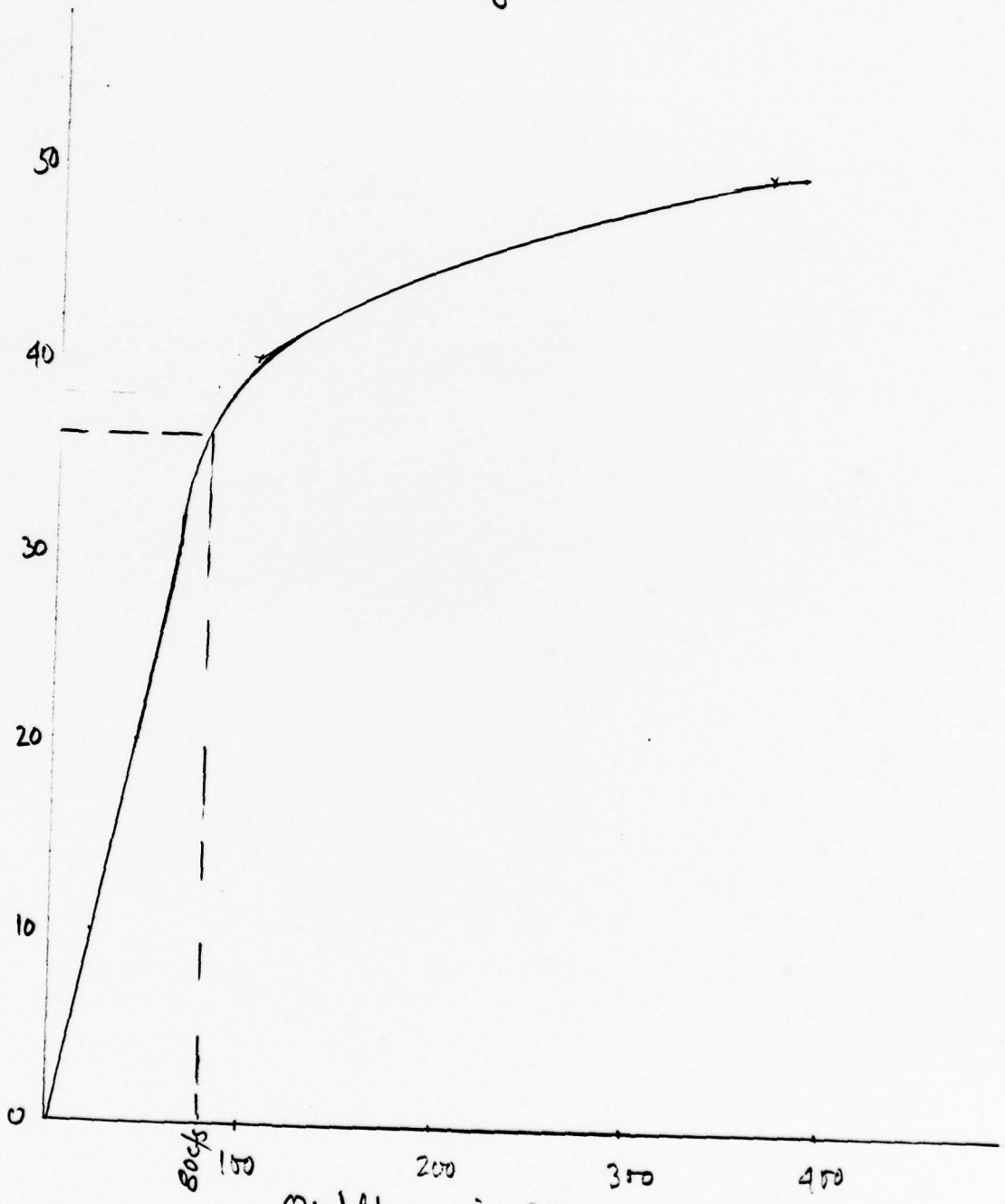
$S = \frac{20}{800} = .025$

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
N.J. ID Name 20
COMPUTED BY S.B. CHECKED BY

SHEET NO. 11 OF
JOB NO. 10-A20-01
DATE July, 1979

Overtopping Potential



Overtopping of Dam occurs at El 562.95
Q = 80 cfs (36% of PMF)

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CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
N.J. NO Name 20
COMPUTED BY S.P.B. CHECKED BY

SHEET NO. 12 OF
JOB NO. 10-A 20-01
DATE July 1979

Overtopping over the Dam

% PMF	Q	Max. WSEL	Max. Feet above Dam	Duration of Flooding	Max WSEL 2,000 Ft DS
10	21	561.29	0	0	470.2
20	42	561.86	0	0	470.4
30	61	562.41	0	0	470.6
40	100	562.96	0	0	470.9
50	367	563.04	0.04	.50	472.7

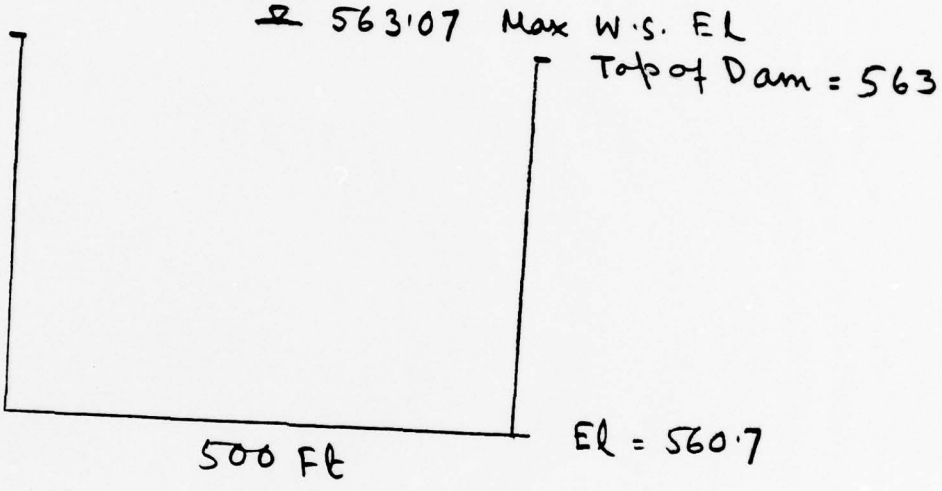
FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
N.J. NO Name 20
COMPUTED BY S.B CHECKED BY

SHEET NO. 13 OF 13
JOB NO. 10-A20-01
DATE July 1979

Breach Analysis

Assume breach begins to develop when reservoir stage reaches above the dam



Effect of breach was analysed 2,000 ft Downstream of the Dam.

Max. Stage without Dam break = 472.7
Max. Stage with Dam break = 474.7

There will be 2' increase in stage due to Dam break.

HEC1-DB

COMPUTER PRINT-OUT

```
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
*********************************
    1              A1       N.J. DAM INSPECTION
    2              A2       N.J NO NAME NO. 20
    3              A3       MUTTIRATIO PMF ROUTING
    4              B    100       0       15       0       0       0       0       0       0       0
    5              B1     5
    6              J      1       5        1
    7              J1    .5      .4       .3      .2      .1
    8              K      0    RES.                                       1
    9              K1       LOCAL INFLOW
   10              M      1       1      .25              .25
   11              P      0      22      112     123      132     143
   12              T                                                  1      .10             .02
   13              W2            .54
   14              X     -1    -0.05       2
   15              K      1       DAM                                 1
   16              K1       ROUTING THROUGH DAM
   17              Y                                      1       1
   18              Y1     1                                                -560.70      -1
   19              Y4 560.7   561.8  562.95     564     566     568     570
   20              Y5     0      40      80    3276   16219   34556   57000
   21              $A     0    36.1      81    99.8
   22              $E   530     561     580     600
   23              $$560.70
   24              $D   563
   25              K      1    REACH1                                 1
   26              K1       CHANNEL ROUTING MOD. PULS. REACH 1
   27              Y                                      1       1
   28              Y1     1
   29              Y6    .10     .05     .10     470     519    2000    .025
   30              Y7     0     520     450     520     700     480     745     470     750     470
   31              Y7   800     480    1075     500    1200     520
   32              K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT RES.
ROUTE HYDROGRAPH TO DAM
ROUTE HYDROGRAPH TO REACH1
END OF NETWORK

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)

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.M SAFETY VERSION     JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 79/08/10.
     TIME= 11.21.15.


                    N.J. DAM INSPECTION
                    N.J NO NAME NO. 20
                    MUTTIRATIO PMF ROUTING

                                JOB SPECIFICATION
      NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
     100        0       15        0        0        0        0        0        0        0
                                JOPER      NWT   LROPT    TRACE
                                    5        0        0        0


                            MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 5 LRTIO= 1
                RTIOS=     .50     .40     .30     .20     .10

**********          **********          **********          **********          **********

                                SUB-AREA RUNOFF COMPUTATION

                LOCAL INFLOW

                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                RES.        0       0       0       0       0       1       0       0

                                HYDROGRAPH DATA
            IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                1       1     .25    0.00     .25    0.00   0.000       0       0       0

                                PRECIP DATA
                    SPFE     PMS      R6     R12     R24     R48     R72     R96
                    0.00   22.00  112.00  123.00  132.00  143.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00     .02

                                UNIT HYDROGRAPH DATA
                            TP=  0.00    CP= .54    NTA=  0

                                RECESSION DATA
                        STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00
TC INCREASED TO THHR OF   .25
R INCREASED TO MINIMUM OF 0.5
CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.00 AND R=  .50 INTERVALS

            UNIT HYDROGRAPH  2 END-OF-PERIOD ORDINATES, LAG=    .20 HOURS, CP=  .50  VOL= 1.00
         323.      323.

                                END-OF-PERIOD FLOW
      0
    MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS     COMP Q      MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS     COMP Q

     1.01    .15       1     .00     .00     .00         0.      1.02    .15      97     .03     .00     .02         1.
     1.01    .30       2     .00     .00     .00         0.      1.02    .30      98     .03     .00     .02         1.
```

1.01	1.00	4	.00	.00	.00	0.	1.02	1.00	100	.03	.00	.02	1.
1.01	1.15	5	.00	.00	.00	0.	0.00	0.00	101	.03	.00	.02	1.
1.01	1.30	6	.00	.00	.00	0.	0.00	0.00	102	.03	.00	.02	1.
1.01	1.45	7	.00	.00	.00	0.	0.00	0.00	103	.03	.00	.02	1.
1.01	2.00	8	.00	.00	.00	0.	0.00	0.00	104	.03	.00	.02	1.
1.01	2.15	9	.00	.00	.00	0.	0.00	0.00	105	.03	.00	.02	1.
1.01	2.30	10	.00	.00	.00	0.	0.00	0.00	106	.03	.00	.02	1.
1.01	2.45	11	.00	.00	.00	0.	0.00	0.00	107	.03	.00	.02	1.
1.01	3.00	12	.00	.00	.00	0.	0.00	0.00	108	.03	.00	.02	1.
1.01	3.15	13	.00	.00	.00	0.	0.00	0.00	109	.03	.00	.02	1.
1.01	3.30	14	.00	.00	.00	0.	0.00	0.00	110	.03	.00	.02	1.
1.01	3.45	15	.00	.00	.00	0.	0.00	0.00	111	.03	.00	.02	1.
1.01	4.00	16	.00	.00	.00	0.	0.00	0.00	112	.03	.00	.02	1.
1.01	4.15	17	.00	.00	.00	0.	0.00	0.00	113	.03	.00	.02	1.
1.01	4.30	18	.00	.00	.00	0.	0.00	0.00	114	.03	.00	.02	1.
1.01	4.45	19	.00	.00	.00	0.	0.00	0.00	115	.03	.00	.02	1.
1.01	5.00	20	.00	.00	.00	0.	0.00	0.00	116	.03	.00	.02	1.
1.01	5.15	21	.00	.00	.00	0.	0.00	0.00	117	.03	.00	.02	1.
1.01	5.30	22	.00	.00	.00	0.	0.00	0.00	118	.03	.00	.02	1.
1.01	5.45	23	.00	.00	.00	0.	0.00	0.00	119	.03	.00	.02	1.
1.01	6.00	24	.00	.00	.00	0.	0.00	0.00	120	.03	.00	.02	1.
1.01	6.15	25	.01	.00	.01	0.	0.00	0.00	121	.08	.06	.02	19.
1.01	6.30	26	.01	.00	.01	0.	0.00	0.00	122	.08	.06	.02	36.
1.01	6.45	27	.01	.00	.01	0.	0.00	0.00	123	.08	.06	.02	36.
1.01	7.00	28	.01	.00	.01	0.	0.00	0.00	124	.08	.06	.02	36.
1.01	7.15	29	.01	.00	.01	0.	0.00	0.00	125	.08	.06	.02	36.
1.01	7.30	30	.01	.00	.01	0.	0.00	0.00	126	.08	.06	.02	36.
1.01	7.45	31	.01	.00	.01	0.	0.00	0.00	127	.08	.06	.02	36.
1.01	8.00	32	.01	.00	.01	0.	0.00	0.00	128	.08	.06	.02	36.
1.01	8.15	33	.01	.00	.01	0.	0.00	0.00	129	.08	.06	.02	36.
1.01	8.30	34	.01	.00	.01	0.	0.00	0.00	130	.08	.06	.02	36.
1.01	8.45	35	.01	.00	.01	0.	0.00	0.00	131	.08	.06	.02	36.
1.01	9.00	36	.01	.00	.01	0.	0.00	0.00	132	.08	.06	.02	36.
1.01	9.15	37	.01	.00	.01	0.	0.00	0.00	133	.08	.06	.02	36.
1.01	9.30	38	.01	.00	.01	0.	0.00	0.00	134	.08	.06	.02	36.
1.01	9.45	39	.01	.00	.01	0.	0.00	0.00	135	.08	.06	.02	36.
1.01	10.00	40	.01	.00	.01	0.	0.00	0.00	136	.08	.06	.02	36.
1.01	10.15	41	.01	.00	.01	0.	0.00	0.00	137	.08	.06	.02	36.
1.01	10.30	42	.01	.00	.01	0.	0.00	0.00	138	.08	.06	.02	36.
1.01	10.45	43	.01	.00	.01	0.	0.00	0.00	139	.08	.06	.02	36.
1.01	11.00	44	.01	.00	.01	0.	0.00	0.00	140	.08	.06	.02	36.
1.01	11.15	45	.01	.00	.01	0.	0.00	0.00	141	.08	.06	.02	36.
1.01	11.30	46	.01	.00	.01	0.	0.00	0.00	142	.08	.06	.02	36.
1.01	11.45	47	.01	.00	.01	0.	0.00	0.00	143	.08	.06	.02	36.
1.01	12.00	48	.01	.00	.01	0.	0.00	0.00	144	.08	.06	.02	36.
1.01	12.15	49	.04	.00	.04	0.	0.00	0.00	145	.49	.47	.02	169.
1.01	12.30	50	.04	.00	.04	1.	0.00	0.00	146	.49	.47	.02	302.
1.01	12.45	51	.04	.00	.04	1.	0.00	0.00	147	.49	.47	.02	302.
1.01	13.00	52	.04	.00	.04	1.	0.00	0.00	148	.49	.47	.02	302.
1.01	13.15	53	.05	.00	.05	1.	0.00	0.00	149	.59	.57	.02	334.
1.01	13.30	54	.05	.00	.05	1.	0.00	0.00	150	.59	.57	.02	366.
1.01	13.45	55	.05	.00	.05	1.	0.00	0.00	151	.59	.57	.02	366.
1.01	14.00	56	.05	.00	.05	1.	0.00	0.00	152	.59	.57	.02	366.
1.01	14.15	57	.06	.00	.06	1.	0.00	0.00	153	.74	.71	.02	413.
1.01	14.30	58	.06	.00	.06	1.	0.00	0.00	154	.74	.71	.02	461.
1.01	14.45	59	.06	.00	.06	1.	0.00	0.00	155	.74	.71	.02	461.
1.01	15.00	60	.06	.00	.06	1.	0.00	0.00	156	.74	.71	.02	461.
1.01	15.15	61	.06	.00	.06	1.	0.00	0.00	157	.75	.72	.02	464.
1.01	15.30	62	.12	.01	.12	4.	0.00	0.00	158	1.50	1.47	.02	709.
1.01	15.45	63	.35	.33	.02	108.	0.00	0.00	159	4.19	4.17	.02	1820.
1.01	16.00	64	.09	.06	.02	125.	0.00	0.00	160	1.05	1.02	.02	1675.
1.01	16.15	65	.06	.03	.02	31.	0.00	0.00	161	.69	.67	.02	545.
1.01	16.30	66	.06	.03	.02	21.	0.00	0.00	162	.69	.67	.02	429.
1.01	16.45	67	.06	.03	.02	21.	0.00	0.00	163	.69	.67	.02	429.
1.01	17.00	68	.06	.03	.02	21.	0.00	0.00	164	.69	.67	.02	429.

1.01	17.15	69	.05	.02	.02	17.	0.00	0.00	165	.54	.52	.02	334.
1.01	17.30	70	.05	.02	.02	13.	0.00	0.00	166	.54	.52	.02	334.
1.01	17.45	71	.05	.02	.02	13.	0.00	0.00	167	.54	.52	.02	334.
1.01	18.00	72	.05	.02	.02	13.	0.00	0.00	168	.54	.52	.02	334.
1.01	18.15	73	.00	.00	.00	7.	0.00	0.00	169	.04	.02	.02	172.
1.01	18.30	74	.00	.00	.00	6.	0.00	0.00	170	.04	.02	.02	88.
1.01	18.45	75	.00	.00	.00	5.	0.00	0.00	171	.04	.02	.02	82.
1.01	19.00	76	.00	.00	.00	5.	0.00	0.00	172	.04	.02	.02	77.
1.01	19.15	77	.00	.00	.00	5.	0.00	0.00	173	.04	.02	.02	71.
1.01	19.30	78	.00	.00	.00	4.	0.00	0.00	174	.04	.02	.02	67.
1.01	19.45	79	.00	.00	.00	4.	0.00	0.00	175	.04	.02	.02	62.
1.01	20.00	80	.00	.00	.00	4.	0.00	0.00	176	.04	.02	.02	58.
1.01	20.15	81	.00	.00	.00	4.	0.00	0.00	177	.04	.02	.02	54.
1.01	20.30	82	.00	.00	.00	3.	0.00	0.00	178	.04	.02	.02	51.
1.01	20.45	83	.00	.00	.00	3.	0.00	0.00	179	.04	.02	.02	47.
1.01	21.00	84	.00	.00	.00	3.	0.00	0.00	180	.04	.02	.02	44.
1.01	21.15	85	.00	.00	.00	3.	0.00	0.00	181	.04	.02	.02	41.
1.01	21.30	86	.00	.00	.00	3.	0.00	0.00	182	.04	.02	.02	38.
1.01	21.45	87	.00	.00	.00	2.	0.00	0.00	183	.04	.02	.02	36.
1.01	22.00	88	.00	.00	.00	2.	0.00	0.00	184	.04	.02	.02	33.
1.01	22.15	89	.00	.00	.00	2.	0.00	0.00	185	.04	.02	.02	31.
1.01	22.30	90	.00	.00	.00	2.	0.00	0.00	186	.04	.02	.02	29.
1.01	22.45	91	.00	.00	.00	2.	0.00	0.00	187	.04	.02	.02	27.
1.01	23.00	92	.00	.00	.00	2.	0.00	0.00	188	.04	.02	.02	25.
1.01	23.15	93	.00	.00	.00	2.	0.00	0.00	189	.04	.02	.02	24.
1.01	23.30	94	.00	.00	.00	1.	0.00	0.00	190	.04	.02	.02	22.
1.01	23.45	95	.00	.00	.00	1.	0.00	0.00	191	.04	.02	.02	21.
1.02	0.00	96	.00	.00	.00	1.	0.00	0.00	192	.04	.02	.02	19.
									SUM	25.17	21.51	3.66	14752.
										(639.)	(546.)	(93.)	(417.73)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1820.	508.	149.	77.	14756.
CMS	52.	14.	4.	2.	418.
INCHES		18.90	22.13	22.88	22.88
MM		479.94	562.23	581.08	581.08
AC-FT		252.	295.	305.	305.
THOUS CU M		311.	364.	376.	376.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	RES.	.25	1	910.	728.	546.	364.	182.
		(.65)		(25.77)(	20.62)(	15.46)(	10.31)(	5.15)(
ROUTED TO	DAM	.25	1	367.	100.	61.	42.	21.
		(.65)		(10.39)(	2.85)(	1.74)(	1.19)(	.60)(
ROUTED TO	REACH1	.25	1	334.	100.	61.	42.	21.
		(.65)		(9.46)(	2.82)(	1.73)(	1.19)(	.60)(

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	560.70	560.70	563.00
STORAGE	362.	362.	449.
OUTFLOW	0.	0.	232.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	563.04	.04	451.	367.	.50	40.25	0.00
.40	562.96	0.00	447.	100.	0.00	42.25	0.00
.30	562.41	0.00	426.	61.	0.00	42.25	0.00
.20	561.86	0.00	405.	42.	0.00	42.25	0.00
.10	561.29	0.00	383.	21.	0.00	42.25	0.00

PLAN 1 STATION REACH1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	334.	472.7	40.50
.40	100.	470.9	42.25
.30	61.	470.6	42.25
.20	42.	470.4	42.25
.10	21.	470.2	42.25

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
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```
     1                A1       N.J. DAM INSPECTION
     2                A2       N.J NO NAME NO. 20
     3                A3        DAM BREAK ANALYSIS
     4                B    100        0       15        0        0        0        0        0        0        0
     5                B1     5
     6                J      1        1        1
     7                J1    .5
     8                K      0    RES.                                                    1
     9                K1       LOCAL INFLOW
    10                M      1        1      .25                .25
    11                P      0       22      112      123      132      143
    12                T                                                       1      .10                .02
    13                W2             .54
    14                X     -1    -0.05        2
    15                K      1      DAM                                               1
    16                K1       ROUTING THROUGH DAM
    17                Y                                        1        1
    18                Y1     1                                                 -560.70      -1
    19                Y4 560.7    561.8   562.95      564      566      568      570
    20                Y5     0       40       80     3276    16219    34556    57000
    21                $A     0     36.1       81     99.8
    22                $E   530      561      580      600
    23                $$560.70
    24                $D   563
    25                $B   500        0    560.7        1   562.95   563.01
    26                K      1   REACH1                                            1
    27                K1       CHANNEL ROUTING MOD. PULS. REACH 1
    28                Y                                        1        1
    29                Y1     1
    30                Y6   .10      .05      .10      470      519     2000     .025
    31                Y7     0      520      450      520      700      480      745      470      750      470
    32                Y7   800      480     1075      500     1200      520
    33                K     99
```

Use t_c = .9 hrs

Lag = 0.6 x .9 = .54 hrs.

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT        RES.
ROUTE HYDROGRAPH TO          DAM
ROUTE HYDROGRAPH TO        REACH1
END OF NETWORK
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE# 79/08/10.
     TIME# 10.45.35.


                        N.J. DAM INSPECTION
                        N.J NO NAME NO. 20
                         DAM BREAK ANALYSIS

                                  JOB SPECIFICATION
          NO      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         100       0       15        0       0        0        0        0        0        0
                                   JOPER     NWT   LROPT   TRACE
                                       5       0       0       0

                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1 NRTIO= 1 LRTIO= 1
                   RTIOS=    .50

**********      **********      **********      **********      **********

                                SUB-AREA RUNOFF COMPUTATION

                LOCAL INFLOW

                                ISTAQ   ICOMP   IECON   ITAPE   JPLT    JPRT    INAME  ISTAGE   IAUTO
                                HES.        0       0       0       0       0        1       0       0

                                            HYDROGRAPH DATA
                IHYDG    IUHG    TAREA    SNAP    TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                    1       1      .25    0.00      .25    0.00   0.000       0       0       0

                                            PRECIP DATA
                            SPFE     PMS      R6      R12     R24     R48     R72     R96
                            0.00   22.00  112.00  123.00  132.00  143.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                            LOSS DATA
           LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
               0    0.00    0.00    1.00    0.00    0.00    1.00     .10    0.00     .02

                                        UNIT HYDROGRAPH DATA
                                    TP=  0.00    CP= .54    NTA=  0

                                        RECESSION DATA
                                STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00
TC INCREASED TO TAMR OF   .25
N INCREASED TO MINIMUM OF 0.5
CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.00 AND R=  .50 INTERVALS

            UNIT HYDROGRAPH  2 END-OF-PERIOD ORDINATES, LAG=    .20 HOURS, CP=  .50  VOL= 1.00
          323.      323.

      0                                 END-OF-PERIOD FLOW
    MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
```

Outflow in cfs

Overtopping of Dam occurs at El 562.95
Q = 80 cfs (36% of PMF)

1.01	.15	1	.00	.00	.00	0.	1.02	.15	97	.03	.00	.02	1.
1.01	.30	2	.00	.00	.00	0.	1.02	.30	98	.03	.00	.02	1.
1.01	.45	3	.00	.00	.00	0.	1.02	.45	99	.03	.00	.02	1.
1.01	1.00	4	.00	.00	.00	0.	1.02	1.00	100	.03	.00	.02	1.
1.01	1.15	5	.00	.00	.00	0.	0.00	0.00	101	.03	.00	.02	1.
1.01	1.30	6	.00	.00	.00	0.	0.00	0.00	102	.03	.00	.02	1.
1.01	1.45	7	.00	.00	.00	0.	0.00	0.00	103	.03	.00	.02	1.
1.01	2.00	8	.00	.00	.00	0.	0.00	0.00	104	.03	.00	.02	1.
1.01	2.15	9	.00	.00	.00	0.	0.00	0.00	105	.03	.00	.02	1.
1.01	2.30	10	.00	.00	.00	0.	0.00	0.00	106	.03	.00	.02	1.
1.01	2.45	11	.00	.00	.00	0.	0.00	0.00	107	.03	.00	.02	1.
1.01	3.00	12	.00	.00	.00	0.	0.00	0.00	108	.03	.00	.02	1.
1.01	3.15	13	.00	.00	.00	0.	0.00	0.00	109	.03	.00	.02	1.
1.01	3.30	14	.00	.00	.00	0.	0.00	0.00	110	.03	.00	.02	1.
1.01	3.45	15	.00	.00	.00	0.	0.00	0.00	111	.03	.00	.02	1.
1.01	4.00	16	.00	.00	.00	0.	0.00	0.00	112	.03	.00	.02	1.
1.01	4.15	17	.00	.00	.00	0.	0.00	0.00	113	.03	.00	.02	1.
1.01	4.30	18	.00	.00	.00	0.	0.00	0.00	114	.03	.00	.02	1.
1.01	4.45	19	.00	.00	.00	0.	0.00	0.00	115	.03	.00	.02	1.
1.01	5.00	20	.00	.00	.00	0.	0.00	0.00	116	.03	.00	.02	1.
1.01	5.15	21	.00	.00	.00	0.	0.00	0.00	117	.03	.00	.02	1.
1.01	5.30	22	.00	.00	.00	0.	0.00	0.00	118	.03	.00	.02	1.
1.01	5.45	23	.00	.00	.00	0.	0.00	0.00	119	.03	.00	.02	1.
1.01	6.00	24	.00	.00	.00	0.	0.00	0.00	120	.03	.00	.02	1.
1.01	6.15	25	.01	.00	.01	0.	0.00	0.00	121	.08	.06	.02	19.
1.01	6.30	26	.01	.00	.01	0.	0.00	0.00	122	.08	.06	.02	36.
1.01	6.45	27	.01	.00	.01	0.	0.00	0.00	123	.08	.06	.02	36.
1.01	7.00	28	.01	.00	.01	0.	0.00	0.00	124	.08	.06	.02	36.
1.01	7.15	29	.01	.00	.01	0.	0.00	0.00	125	.08	.06	.02	36.
1.01	7.30	30	.01	.00	.01	0.	0.00	0.00	126	.08	.06	.02	36.
1.01	7.45	31	.01	.00	.01	0.	0.00	0.00	127	.08	.06	.02	36.
1.01	8.00	32	.01	.00	.01	0.	0.00	0.00	128	.08	.06	.02	36.
1.01	8.15	33	.01	.00	.01	0.	0.00	0.00	129	.08	.06	.02	36.
1.01	8.30	34	.01	.00	.01	0.	0.00	0.00	130	.08	.06	.02	36.
1.01	8.45	35	.01	.00	.01	0.	0.00	0.00	131	.08	.06	.02	36.
1.01	9.00	36	.01	.00	.01	0.	0.00	0.00	132	.08	.06	.02	36.
1.01	9.15	37	.01	.00	.01	0.	0.00	0.00	133	.08	.06	.02	36.
1.01	9.30	38	.01	.00	.01	0.	0.00	0.00	134	.08	.06	.02	36.
1.01	9.45	39	.01	.00	.01	0.	0.00	0.00	135	.08	.06	.02	36.
1.01	10.00	40	.01	.00	.01	0.	0.00	0.00	136	.08	.06	.02	36.
1.01	10.15	41	.01	.00	.01	0.	0.00	0.00	137	.08	.06	.02	36.
1.01	10.30	42	.01	.00	.01	0.	0.00	0.00	138	.08	.06	.02	36.
1.01	10.45	43	.01	.00	.01	0.	0.00	0.00	139	.08	.06	.02	36.
1.01	11.00	44	.01	.00	.01	0.	0.00	0.00	140	.08	.06	.02	36.
1.01	11.15	45	.01	.00	.01	0.	0.00	0.00	141	.08	.06	.02	36.
1.01	11.30	46	.01	.00	.01	0.	0.00	0.00	142	.08	.06	.02	36.
1.01	11.45	47	.01	.00	.01	0.	0.00	0.00	143	.08	.06	.02	36.
1.01	12.00	48	.01	.00	.01	0.	0.00	0.00	144	.08	.06	.02	36.
1.01	12.15	49	.04	.00	.04	0.	0.00	0.00	145	.49	.47	.02	169.
1.01	12.30	50	.04	.00	.04	1.	0.00	0.00	146	.49	.47	.02	302.
1.01	12.45	51	.04	.00	.04	1.	0.00	0.00	147	.49	.47	.02	302.
1.01	13.00	52	.04	.00	.04	1.	0.00	0.00	148	.49	.47	.02	302.
1.01	13.15	53	.05	.00	.05	1.	0.00	0.00	149	.59	.57	.02	334.
1.01	13.30	54	.05	.00	.05	1.	0.00	0.00	150	.59	.57	.02	366.
1.01	13.45	55	.05	.00	.05	1.	0.00	0.00	151	.59	.57	.02	366.
1.01	14.00	56	.05	.00	.05	1.	0.00	0.00	152	.59	.57	.02	366.
1.01	14.15	57	.06	.00	.06	1.	0.00	0.00	153	.74	.71	.02	413.
1.01	14.30	58	.06	.00	.06	1.	0.00	0.00	154	.74	.71	.02	461.
1.01	14.45	59	.06	.00	.06	1.	0.00	0.00	155	.74	.71	.02	461.
1.01	15.00	60	.06	.00	.06	1.	0.00	0.00	156	.74	.71	.02	461.
1.01	15.15	61	.06	.00	.06	1.	0.00	0.00	157	.75	.72	.02	464.
1.01	15.30	62	.12	.01	.12	4.	0.00	0.00	158	1.50	1.47	.02	709.
1.01	15.45	63	.35	.33	.02	108.	0.00	0.00	159	4.19	4.17	.02	1820.
1.01	16.00	64	.09	.06	.02	125.	0.00	0.00	160	1.05	1.02	.02	1675.
1.01	16.15	65	.06	.03	.02	31.	0.00	0.00	161	.69	.67	.02	545.

1.01	16.30	66	.06	.03	.02	21.	0.00	0.00	162	.69	.67	.02	429.
1.01	16.45	67	.06	.03	.02	21.	0.00	0.00	163	.69	.67	.02	429.
1.01	17.00	68	.06	.03	.02	21.	0.00	0.00	164	.69	.67	.02	429.
1.01	17.15	69	.05	.02	.02	17.	0.00	0.00	165	.54	.52	.02	382.
1.01	17.30	70	.05	.02	.02	13.	0.00	0.00	166	.54	.52	.02	334.
1.01	17.45	71	.05	.02	.02	13.	0.00	0.00	167	.54	.52	.02	334.
1.01	18.00	72	.05	.02	.02	13.	0.00	0.00	168	.54	.52	.02	334.
1.01	18.15	73	.00	.00	.00	7.	0.00	0.00	169	.04	.02	.02	172.
1.01	18.30	74	.00	.00	.00	6.	0.00	0.00	170	.04	.02	.02	88.
1.01	18.45	75	.00	.00	.00	5.	0.00	0.00	171	.04	.02	.02	82.
1.01	19.00	76	.00	.00	.00	5.	0.00	0.00	172	.04	.02	.02	77.
1.01	19.15	77	.00	.00	.00	5.	0.00	0.00	173	.04	.02	.02	71.
1.01	19.30	78	.00	.00	.00	4.	0.00	0.00	174	.04	.02	.02	67.
1.01	19.45	79	.00	.00	.00	4.	0.00	0.00	175	.04	.02	.02	62.
1.01	20.00	80	.00	.00	.00	4.	0.00	0.00	176	.04	.02	.02	58.
1.01	20.15	81	.00	.00	.00	4.	0.00	0.00	177	.04	.02	.02	54.
1.01	20.30	82	.00	.00	.00	3.	0.00	0.00	178	.04	.02	.02	51.
1.01	20.45	83	.00	.00	.00	3.	0.00	0.00	179	.04	.02	.02	47.
1.01	21.00	84	.00	.00	.00	3.	0.00	0.00	180	.04	.02	.02	44.
1.01	21.15	85	.00	.00	.00	3.	0.00	0.00	181	.04	.02	.02	41.
1.01	21.30	86	.00	.00	.00	3.	0.00	0.00	182	.04	.02	.02	38.
1.01	21.45	87	.00	.00	.00	2.	0.00	0.00	183	.04	.02	.02	36.
1.01	22.00	88	.00	.00	.00	2.	0.00	0.00	184	.04	.02	.02	33.
1.01	22.15	89	.00	.00	.00	2.	0.00	0.00	185	.04	.02	.02	31.
1.01	22.30	90	.00	.00	.00	2.	0.00	0.00	186	.04	.02	.02	29.
1.01	22.45	91	.00	.00	.00	2.	0.00	0.00	187	.04	.02	.02	27.
1.01	23.00	92	.00	.00	.00	2.	0.00	0.00	188	.04	.02	.02	25.
1.01	23.15	93	.00	.00	.00	2.	0.00	0.00	189	.04	.02	.02	24.
1.01	23.30	94	.00	.00	.00	1.	0.00	0.00	190	.04	.02	.02	22.
1.01	23.45	95	.00	.00	.00	1.	0.00	0.00	191	.04	.02	.02	21.
1.02	0.00	96	.00	.00	.00	1.	0.00	0.00	192	.04	.02	.02	19.
									SUM	25.17	21.51	3.66	14752.
										(639.)	(546.)	(93.)	(417.73)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1820.	508.	149.	77.	14756.
CMS	52.	14.	4.	2.	418.
INCHES		18.90	22.13	22.88	22.88
MM		479.94	562.23	581.08	581.08
AC-FT		252.	295.	305.	305.
THOUS CU M		311.	364.	376.	376.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50
HYDROGRAPH AT	RES.	.25	1	910.
		(.65)		(25.77)(
ROUTED TO	DAM	.25	1	1221.
		(.65)		(34.57)(
ROUTED TO	REACH1	.25	1	1212.
		(.65)		(34.31)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	562.95	560.70	563.00
STORAGE	447.	362.	449.
OUTFLOW	80.	0.	232.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	563.08	.08	452.	1223.	.40	41.19	40.25

PLAN 1 STATION REACH1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1212.	474.7	41.00